Key Outcomes Memorandum
for the
Water Management Science Board Kick-Off Meeting
Convened January 26-27, 2005
Sacramento, CA

February 22, 2005

To: WMSB Members

From: Jack Keller and Scott McCreary / Xantha Bruso

Through: Tom Gohring

Re: Key Outcomes of the January 26-27, 2005 WMSB Meeting

SUMMARY

The Water Management Science Board (WMSB) convened its plenary kick-off meeting in Sacramento on January 26-27, 2005. This Key Outcomes Memorandum provides a detailed overview of meeting discussions, conclusions, and next steps. It was reviewed in draft by the Interim WMSB Chair, WMSB members, and key staff. CBDA staff, implementing agency staff, and BDPAC Subcommittee chairs or representatives who gave briefings at the meeting also reviewed it. Their edits are all reflected here. Below is a summary of the primary presentations, discussions, and outcomes of the meeting.

Orientation Briefings and Collegial Board Dialogue

- The meeting provided an opportunity for Board members to get a firm grounding in the CALFED Program. They received briefings by California Bay-Delta Authority (CBDA) and implementing agency staff on CBDA's structure, the Water Management Program, individual program elements, the relationship between the three science boards, and the WMSB's role and responsibilities. Additionally, the meeting afforded an opportunity for Board members to begin building collegial relationships.

Issues for WMSB Consideration

- Board members concluded that the framing of problem statements should be iterative, with CBDA staff framing initial questions for the WMSB to then revise. They also deemed it likely that the Board itself will frame additional questions. Board members expressed a preference to give priority to basic integrative science questions used to inform management decisions.

- Board members were provided a 1/26/04 draft memorandum entitled "Water Supply" by Tom Dunne, ISB Chair, regarding an anticipated request that the WMSB consider questions on the increased pumping capacity proposed in the 8500 plan of the Delta Improvements Package. Board members agreed to establish a Delta Improvements Program Task Force as a placeholder, and to await the results of the Feb 22-23 ISB meeting to inform its course of action.

Preferred WMSB Meeting Frequency

- Board members agreed that the Board would benefit from more frequent plenary meetings (one every three to four months). They observed that plenary meetings presented an important opportunity for cross-element integration. They also recommended frequent Board-staff interaction.

Formation of WMSB Executive Committee

- Board members supported Jack Keller's proposal to form a WMSB Executive Committee staffed by him, ISB and ERPSB member Bob Twiss, and ISB and EWARP member Helen Ingram. The Executive Committee will work with Tom Gohring and Scott McCreary in planning and preparing for future WMSB meetings.

Formation of Subcommittees and Task Forces / Initial Problem Statements

- Board members agreed to establish four Subcommittees as a useful organizing structure for the work of the WMSB. The four Subcommittees are:
  - Water Quality (with initial focus on drinking water but with responsibility for all water sources and uses in the BD system with the exception of ecosystem restoration)
  - Agricultural and Urban Water Use Efficiency and Water Recycling
  - Water Supply and Modeling/CALSIM
  - Organizational and Policy Change and Adaptive Management

  These WMSB Subcommittees will be a key point of contact for CBDA Program staff and BDPAC Subcommittees.

- Board members considered the merits of convening Task Forces, acknowledging that the formation of Task Forces depends on budget availability. The three proposed Task Forces are:
  - Levee System Integrity Risk Analysis
  - Common Assumptions and Water Demand
  - Water Management Aspects of the Delta Improvements Package (DIP)

- The Board concluded that not all Subcommittees and Task Forces will be convened immediately. Initial work will focus on Water Quality, Common Assumptions and Water Demand and the DIP. To the extent possible, the first drafts of problem statement or questions for these committees will be drafted by staff and then refined by each Subcommittee/Task Force via email and/or teleconference in advance of the WMSB's next plenary meeting.

Identification of Information Needs

- The Board requested that CBDA program staff compile the latest most salient work products of each program related to the Subcommittees and Task Forces. Staff will transmit these documents plus a short annotated bibliography of relevant web links within about a month's time.

- The Board also requested that WMSB staff establish a website from which Board members can download the presentations and other briefing materials presented at the meeting. Staff committed to email Board members the URL for this site within about two weeks' time.

Format of Deliverables

- The Board agreed that the format of the deliverables they produce would depend on the questions they sought to answer. They noted that they would conceivably produce memoranda, reports, and recommendations.

Inclusion of Watershed Management as a Key Water Management Element in the WMSB Process

- WMSB members recognized the importance of the Watershed Management element, asked that a briefing on the element be given at a future WMSB meeting, and urged that it be incorporated in the ongoing WMSB process of framing and deliberation of issues.

Recognition of Key Role of BDPAC Subcommittees as Key Point of Contact

- CBDA staff and WMSB members recognized the role of BDPAC Subcommittees as a key point of contact with the stakeholder community.

Potential Topics for Future Consideration

- The Board began but did not finalize approaches to several topics that may be reflected in its Terms of Reference. These issues, which may be raised again by the Board for future consideration, include:
  - Deliberation on the development of an integrated quantitative information system;
  - Use of a water balance hydrograph lens and flowpaths with quantifiable objectives as a organizing framework for water management; and
  - Consideration of how issues such as energy, infrastructure, and public health might be integrated into the WMSB Terms of Reference.

Updating the WMSB Terms of Reference (TOR) to Reflect Deliberations

- Jack Keller and Scott McCreary will work with Tom Gohring to update the Board's Terms of Reference to reflect the deliberations and results of the WMSB's January 26-27 meeting.

Convening the Next WMSB Plenary Meeting in April or May, 2005

- The Board agreed to strive to meet in April or May 2005, pending resolution of scheduling and budget issues.

TABLE OF CONTENTS

MEETING BACKGROUND

Purpose of the WMSB

CBDA convened the WMSB to provide overarching review and coordination of program strategies, plans, and specific issues of strategic importance for program elements that contribute to the CALFED Goals of Water Supply Reliability, Levee System Integrity, and Improved Water Quality.

Background of the WMSB

CALFED manages a cooperative effort among state and federal agencies and the public to ensure a healthy ecosystem, reliable water supplies, good quality water, and stable levees in California's Bay-Delta system. Water Supply Reliability, Improved Levee System Integrity, and Improved Water Quality are three of CALFED's four resource management goals. The CALFED program elements are being implemented by several state and federal agencies with oversight and coordination from the CBDA.

The August 2000 Record of Decision (ROD) established the CALFED Science Program. Its purpose is to "provide a comprehensive framework and develop new information and scientific interpretations necessary to implement, monitor, and evaluate the success of the CBDA Program (including all program components), and to communicate to managers and the public the state of knowledge of issues critical to achieving CALFED goals."

The Science Program seeks advice about approaches, relative to the state of science, but does not necessarily seek consensus advice in that regard. Where a diversity of opinion or contradictory conclusions arises in Science Board discussions, this should be expressed; where consensus occurs, that should be noted.

The ROD further recommends that individual program elements convene their own independent science boards or panels, either as standing bodies or on an as-needed basis, to "help ensure the best investments are being made and results are being achieved, as well as form strategies to reduce scientific uncertainties." The WMSB is one of these boards, and focuses on the following eight program elements that are organized under the Water Management Program.

- Water Management
- Storage
- Conveyance
- Water Use Efficiency
- Water Transfers
- Environmental Water Account
- Water Quality
- Watershed Management
- Levee System Integrity

Participants in the WMSB Meeting

The Panel meeting was attended by all sixteen WMSB members, CBDA staff and consultants, implementing agency staff, BDPAC Subcommittee chairs and/or members, BDPAC members, and members of the public. A list of WMSB members and key staff is provided in **Table 1 - WMSB Members and Key Staff** below.

Table 1 - WMSB Members and Key Staff

WMSB MEMBERS		
Name	**Title**	**Expertise**
Michael Anderson	Professor, Dept. of Environmental Science, UC Riverside	Aquatic chemistry, toxicology, and microbiology
Takashi Asano	Professor Emeritus, Civil and Environmental Engineering, UC Davis	Water recycling and desalination
Tom Chesnutt	Co-Founder, A&N Technical Services, Inc.	Urban water conservation
Michael Dettinger	Research Hydrologist, USGS and Scripps Institute of Oceanography	Surface water hydrology and storage
Jody Emel	Professor, Graduate School of Geography, Clark University	Social geography (water, environment, place and space)
William Glaze*	Professor, Dept. of Environmental and Biomolecular Systems, Oregon Health and Science University	Water quality and drinking water treatment
Helen Ingram*	Professor, School of Social Ecology, UC Irvine	Water policy and analysis
Jack Keller**	Principal, Keller-Bliesner Engineering	Agricultural water management
Denise Lach	Professor, Dept. of Sociology, Co-Director, Center for Water and Environmental Sustainability, Oregon State University	Organizational and behavioral dynamics
Daene McKinney	Professor, Dept. of Civil Engineering, University of Texas, Austin	Water resources and river basin modeling
John Melack*	Professor, Bren School, Dept. of Ecology, Evolution, and Marine Biology, UC Santa Barbara	Aquatic ecology
Stephen Monismith	Professor, Dept. of Civil and Environmental Engineering, Stanford University	Water conveyance through constructed & natural systems
Richard Norgaard	Professor of Energy and Resources and of Agricultural and Resource Economics, UC Berkeley	Environmental economics
Robert Twiss*	Professor, Graduate Center for Environmental Design Research, UC Berkeley	Water management/ecosystem restoration interaction
Dennis Wichelns	Professor of Agricultural Economics, CSU Fresno	Resource economics
William Woessner	Professor of Hydrogeology, University of Montana	Groundwater hydrology
* Member of CALFED Independent Science Board (ISB) ** Interim WMSB Chair		
KEY STAFF TO WMSB		
Tom Gohring	Deputy Director, Water Management & Regional Coordination	CBDA
Scott McCreary	Principal Facilitator	CONCUR, Inc.
Xantha Bruso	Associate Facilitator	CONCUR, Inc.
Valerie Castro	Administrative Officer, Water Management Division	CBDA

ORIENTATION BRIEFINGS

Orientation on CBDA and Overview of Water Management Program

In his introductory briefing, CBDA Director Patrick Wright highlighted the Authority's strong commitment to science through both its robust funding of the Science Program and its invitation to WMSB Members to take an active, sustained, and forward-looking approach to Water Management issues. Indeed, as CBDA Lead Scientist Johnnie Moore outlined in his ensuing presentation on the demographic trends in California and the challenges they pose, the WMSB will need to take a long-term view to face the challenge of how to reliably supply quality water to an increasingly urbanized and populous state.

CBDA Deputy Director of Water Management & Regional Coordination Tom Gohring then gave an overview of CBDA's structure and the role of the Water Management Program. He clarified that CBDA is responsible for oversight and coordination of CALFED, which is a cooperative effort among more than twenty state and federal agencies and the public to achieve four broad resource management goals as outlined in CALFED's August 2000 Record of Decision (ROD). CALFED's four goals are:

- Water supply reliability
- Drinking water quality
- Levee system integrity
- Ecosystem restoration

CBDA's oversight and coordination role is to ensure that the implementing agencies fulfill the goals of the ROD, use sound science, and provide for public participation. CBDA has therefore established eleven program elements, each of which links to several implementing agencies. The eleven program elements are:

- Water Management
- Storage
- Conveyance
- Water Use Efficiency
- Water Transfers
- Environmental Water Account
- Drinking Water Quality
- Watershed Management
- Levee System Integrity
- Ecosystem Restoration
- Science

The two main participants in each program element are:

- CBDA and implementing agency staff
- Bay-Delta Public Advisory (BDPAC) Subcommittee members

In addition, each program element may draw on the advice of one or more independent scientific review bodies. The Ecosystem Restoration Program and now the Water Management Program each have their own Science Board. All program elements may draw on advice from the Independent Science Board (ISB), whose charge is to "advise and make recommendations to the Authority and the Bay-Delta Public Advisory Committee, as appropriate, on the science relative to the implementation of all program elements" (Water Code sec. 79470(a)).

Purpose of the Water Management Science Board

CBDA convened the Water Management Science Board (WMSB) to provide overarching review and coordination of strategies, plans, and specific issues of strategic importance that contribute to the CALFED Goals of Water Supply Reliability, Levee System Integrity, and Improved Water Quality. The eight program elements organized under the Water Management Program that are the focus of this Board include:

- Water Management
- Storage
- Conveyance
- Water Use Efficiency
- Water Transfers
- Environmental Water Account
- Drinking Water Quality
- Levee System Integrity

In his presentation on the "Water Management Vision of the CBDA", WMSB Interim Chair Jack Keller presented a synoptic overview using monthly hydrographs to demonstrate the way the sum of the various elements of water supply are equal to the total water supply that is then distributed among the various demands. This overview also showed the water balance supply-demand mismatches and how water transfers may be used to handle the demand shortfalls. He emphasized that public policy and behavioral changes, along with water flow controls, are the key tools of CBDA's Water Management Program. The broad inclusion of economists and social scientists on the WMSB along with physical scientists and engineers is both a product and reflection of this view. This view was also supported by Tom Gohring, who observed that water management has shifted from being primarily an issue of maximizing water supply to being a complementary, integrative approach that seeks to optimize many aspects of California's water system.

PROGRAM ELEMENT BRIEFINGS

Day 1 featured a series of briefings on program elements and specific issues by CBDA and implementing agency staff. Chairs or representatives of the Water Supply, Drinking Water Quality, and Water Use Efficiency BDPAC Subcommittees also briefed the WMSB. **Table 2 - Program Element Briefings** lists the briefings presented. ATTACHMENT 1 (PROGRAM ELEMENT BRIEFINGS) contains a detailed summary of these briefings.

Table 2 - Program Element Briefings

Briefing Topic	Presenter
Water Supply ▪ Ground Water Storage ▪ Surface Water Storage ▪ Water Transfers ▪ Conveyance ▪ Delta Improvements Package	Mark Roberson, CBDA Staff ▪ John Woodling, Department of Water Resources ▪ Nannette Engelbrite, US Bureau of Reclamation ▪ Mark Roberson, CBDA Staff ▪ Don Kurosaka, Department of Water Resources ▪ Ron Ott, CBDA Staff
Water Supply Subcommittee	Mark Cowin, Department of Water Resources
Drinking Water Quality	Lisa Holm, CBDA Staff Liz Borowiec, EPA Region 9
Water Quality Subcommittee	Chair Greg Gartrell, Contra Costa Water District
Water Use Efficiency	Tom Gohring and Mark Roberson, CBDA Staff
Water Use Efficiency Subcommittee	Co-Chair Fran Spivy-Weber, Mono Lake Committee
Levee System Integrity	Sergio Guillen, CBDA Staff Curt Schmutte, Department of Water Resources
Environmental Justice	Ken McGhee, CBDA Consultant
Coordination of integrated quantitative information capability development	Ken Kirby, DWR Consultant

BRIEFING ON WMSB ROLES AND RESPONSIBILITIES

In reviewing the WMSB's scope, Jack Keller referred to two documents: the WMSB Terms of Reference (TOR) and a companion document recommending four Standing Panels and several issue-specific Task Forces as a potential structure for the Board. At the conclusion of the program element briefings, several Board members proposed that the WMSB would operate more effectively if it remained a plenary group for a few months longer and met relatively more often (3-4 times a year as opposed to 1-2 times a year). Their reasoning was twofold. First, as the Water Management Program is divided into several overlapping program elements, the value of the WMSB would be greater if its diverse members were able to forge an identity and gain a better long-term overview before organizing into smaller groups. Second, the members assigned to the Organizational Change Standing Panel felt that their expertise could be beneficially applied to the issue-oriented Standing Panels.

Jack Keller supported his fellow Board members' desire for more plenary meetings in the early work of the WMSB. He also proposed revising the term "Standing Panels" to "Subcommittees," to which all Board members concurred. In addition, he gained agreement from the Board on forming a WMSB Executive Committee that he, Bob Twiss, and Helen Ingram would staff to work alongside Tom Gohring and Scott McCreary. Keller said he proposed including both Twiss and Ingram as they each serve on other CALFED science panels (Twiss on all three boards, and Ingram on the ISB and the EWARP.)

Board members also discussed the desired format for their meetings. Helen Ingram praised the quality of the meeting's presentations and the high level of staff interaction, and recommended that the Board continue to interact dynamically with staff in future meetings. Bob Twiss commented that he, Tom Gohring, and Scott McCreary had communicated extensively with staff through emails and "scouting" discussions in advance of this meeting to ensure that presentations would contain the information necessary to properly orient the WMSB.

The Board also discussed the "look and feel" of deliverables they might produce. They generally agreed that the deliverables' formats would depend on the questions they sought to answer, and that they would conceivably produce reports, recommendations, and memoranda.

Additionally, Board members asked about how they should address stakeholder involvement. Scott McCreary noted that several past independent scientific panels had benefited from convening ad-hoc stakeholder work groups as a sounding board for independent scientific review. CBDA staff stated that most stakeholder involvement occurs in the Subcommittees, thus having a sounding board of senior stakeholders as was done for the independent review of water conservation potential would indeed be a good option. Stakeholders are also entitled to attend and speak at the WMSB's meetings and/or write letters to the WMSB Chair, Water Management Program Manager, or Lead Scientist.

The Board and key staff then discussed at length the issue of the questions the WMSB would address, who frames them, and the order in which they should be considered. While some Board members preferred to receive several framed questions from the CBDA for the WMSB to discuss, other members and staff recommended that the WMSB take time to frame its own agenda. The conclusion of this conversation was that the framing of problem statements is to be iterative, with CBDA staff framing initial questions for the WMSB to then revise. It was also deemed likely that the WMSB would frame additional questions, with priority going to basic integrative science questions used to inform management decisions. Scott McCreary noted in additions that the budget of CBDA must be considered in the WMSB's operation.

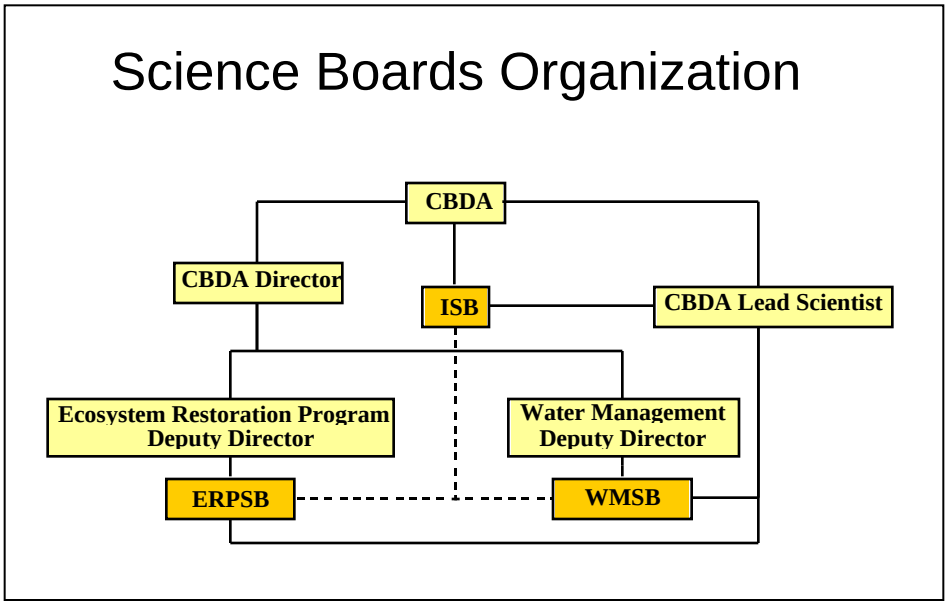
On a related topic, staff distributed a draft memorandum from ISB Chair Tom Dunne notifying the WMSB that it will likely be asked to consider questions relating to the increased pumping capacity proposed in the 8500 plan of the Delta Improvements Package (DIP). Dunne wrote, "At the February 22-23 ISB meeting, it is expected that the ISB will request the Water Management Science Board (WMSB) consider by what methods do the CALFED programs address assumptions and current methods of projecting water yield, supply and pumping and how the changes in flow to be expected from the new pumping regime are likely to affect aquatic habitat throughout the system." WMSB members agreed to take this request under consideration as they move forward to form their Subcommittees and Task Forces.

BRIEFING ON CALFED SCIENCE BOARDS AND SCIENCE PROGRAM

On Day 2 of the meeting, Lead Scientist Johnnie Moore gave a presentation on the relationship between the ISB, the WMSB, and the Ecosystem Restoration Program Science Board (ERPSB). He began by introducing his mandate, which is to integrate science into all aspects of the Authority. He noted that he works directly with the ISB, and is in charge of the Science Program Proposal Solicitation Package (PSP). He recommended that Board members read about the PSP process, as it reviews applications to invest in projects that develop new knowledge about how water use and management activities interact with and affect key aquatic species and environmental processes across spatial and temporal scales. He also mentioned the conferences, workshops, publications, grants, post-docs, and research assistantships supported by the Science Program.

He explained that while the members of the ERPSB and the WMSB were suggested and vetted by their program elements' respective BDPAC Subcommittee members, the Lead Scientist nominates ISB members. Furthermore, while the ERPSB and WMSB are more program element-specific, the ISB's reach spans all program elements. He went on to clarify the management structure of the science boards, namely, that the Ecosystem Restoration Program Manager manages the ERPSB, the Water Management Program Manager manages the WMSB, and the Lead Scientist manages the ISB, as illustrated in the figure below.

Figure 1 - Organization of Science Boards



Following this presentation, Board members discussed a variety of ways that science advising might take shape in the Board's work. Among the points made were that many current CALFED issues involve matters of engineering practice (as opposed to science), and that framing the underlying scientific questions inherent in policy choices could be a key contribution.

It was noted that while the issues the Board is to address are complex, an even broader view is needed to integrate issues such as of energy, infrastructure, and public health into the Board's water-centered focus. Scott McCreary and Jack Keller noted that a close look at the TOR would be in order to ensure these considerations are addressed.

Ecosystem Restoration Program Science Board (ERPSB)

Bob Twiss, who sits on all three science boards, gave a briefing on the work of the ERPSB, which has met approximately every ten weeks since 1999. Among his "lessons learned" were that having board members who have been involved in the management of large science or environmental management programs has been beneficial, and that building collegial working relationships among board members has proved important.

Twiss described the work of the ERPSB, which has included investigating the science basis for program expenditures (such as fish screens), identifying sources of uncertainty delaying solutions to various science questions, reviewing project design to increase knowledge gained, and testing conceptual models, modeling, and adaptive management strategies. The ERPSB also evaluated the ERP's progress on clarification and implementation of ROD milestones. Twiss noted that when certain milestones were not easily measurable, the ERP, working with consultants and CALFED constituent agency staff, parsed them into consistent categories (plans, tools, etc.), and tried to objectify them in clearer terms. He also noted that the ERPSB has commissioned white papers, written numerous memos to the ERP Deputy Director, one annual report, and one journal article authored by the full board. However, overall, they have not produced as extensive documentation of their work as they would like, and are working to formalize the board’s work products.

Environmental Water Account Review Panel (EWARP)

Helen Ingram, as a member of both the ISB and the EWARP, gave an overview of the EWARP's work. The EWA provides flexibility for water project operators to respond to real time changes in knowledge about fish and other ecosystem concerns. The EWARP was convened to provide scientific review of the EWA due to stakeholder concerns regarding the effect of water transfers and water markets on fish and fish habitat. Ingram noted that as a social experiment, the EWARP was an organizational success because biologists and water project operators came to understand each other better. It was also valuable because it provided information from outside experts. In addition, because the EWARP needed materials to review, it encouraged stakeholders to work together and produce sound science.

COORDINATION OF INTEGRATED QUANTITATIVE INFORMATION CAPABILITY DEVELOPMENT

Ken Kirby, consultant to DWR, presented some ideas for providing better coordination for the development and evolution of analytical capability to provide the integrated quantitative information needed to more comprehensively address California's long-range water management questions. He explained that CBDA and implementing agencies have been using a variety of different models and other analytical tools, and that many of these models and tools were developed years ago for different purposes than the questions the agencies are being asked to answer today. He has therefore proposed that a group be convened to improve communication between technical experts and policy makers about what is required and how to develop the analytical capability necessary to address these broad policy questions. He is seeking both potential members and support for this group, as well as an institutional home for it.

Kirby stated that he has been asked by DWR to investigate the feasibility of and interest in this concept. He seeks to involve other agencies because the broad areas of analytical expertise required to meet current policy information needs necessitates close coordination among agencies to provide more responsive, integrated analytical tools. He discussed the concomitant need to develop a coordinated management structure, in which staff and infrastructure resources are identified and developed to be able to produce such tools.

The WMSB had a number of comments and suggestions. One member noted that part of the challenge of developing such a system is changing organizational culture and the way in which bureaucracy is structured. Kirby agreed and noted that change needs to be instigated internally (within DWR) as well as applied externally (from CBDA and other implementing agencies). It was also recommended that Kirby confer with Staff or the Chair of the ISB (Tom Dunne) since the ISB is now considering the creation of task force to consider the development of a comprehensive observation and forecasting system for the Bay-Delta system. Another Board member queried whether the CALFED Science Consortium might be a better home for this initiative. Tom Gohring complimented DWR's progressive approach to information management and the integration of science, economics, and policy, and the Board as a whole indicated their support for this initiative, but recommended that it be given greater definition and clarity. In response to the Board's request for more written information, Kirby distributed a two-page memo summarizing an idea for how to improve coordination involving the development, maintenance, and application of quantitative information capability.

INTRODUCTIONS BY WMSB MEMBERS

Board members and key staff each introduced themselves and shared how they became interested in their fields of work, why their work is important to them, and how they see their expertise being applied in the WMSB. Their introductions revealed a wide range of interests, an interdisciplinary mix of expertise, a combination of both research and practice, and experience both inside and outside California.

During the course of the introductions, several Board members requested field trips to sites in the Bay-Delta region, and one Board member noted that while the meeting had focused primarily on issues concerning the Delta, the WMSB should not overlook its oversight role regarding the health of San Francisco Bay.

PUBLIC COMMENT

Gary Bobker, Program Director at the Bay Institute, praised the Water Management Program as a more synthetic approach that can address the integration of program elements. He urged the Board not to lose sight of the Water Management Program's conceptual framework and the goals CALFED was established to achieve.
He noted that at a macroscopic level, CALFED is an amalgamation of competing assumptions in a system that is highly manipulated. Because of this, he stated that there should be a preferred hydrograph that optimizes protection and uses. He acknowledged that assumptions about a preferred hydrograph would likely conflict, and that therefore the science boards need to take a system-wide perspective.

He also noted that while an ecosystem-based perspective looks at connectivity, the Board needs to critically review the disconnects within the system. The system's complexity makes it very vulnerable, so he asked the Board to consider how it could be made more robust. He also expressed the view that CALFED will not realistically be able to continue its current distribution system indefinitely in the face of seismic and climate change challenges. In conclusion, he suggested the Board identify a framework for water management for this system.

DISCUSSION ON THE SCOPE OF THE WMSB

Daene McKinney noted that articulating a water management framework for this system would be useful, but suggested that both the scale of this framework and how it would relate to the goals of the Water Management Program needs further clarification. Other Board members followed with questions about whether there was a framework by which tools are being applied, and if there was a rational way these tools are being used to achieve goals.

Board members questioned the availability of and need for 300 MAF more storage capacity. They wanted more information to determine whether this "tool" of 300 MAF addresses the "goal" of water supply reliability, but did not want to have to "reinvent the wheel". The larger question emerged about whether there will be a shortage of water in California, and what can be done about it. Tom Chesnutt noted that many of the ISB's questions in Tom Dunne's draft memo on the DIP concerned demand. He suggested the Board consider using demand-based information to quantify future storage needs and changing use patterns to determine a variety of scenarios instead of using one single number. He noted that one cannot accurately assess the value of storage without a solid empirical understanding of demand. Other members noted that while current tools can be used to look 3-4 years ahead, the Board needs to think longer-term (10-15 years ahead).

Board members queried how Watershed Management as a program element fits within Water Management, requested a briefing on this element at a future WMSB meeting, and suggested that Watershed Management be explicitly brought within the scope of the WMSB's activities.

Other Board members sought additional insight on demand management and the intended distribution and end users associated with potential additional water yield. CBDA staff mentioned the Common Assumptions team, which is part of surface storage investigation and will be producing studies on these issues.

FORMATION OF SUBCOMMITTEES

As noted in the section "Briefing on WMSB Roles and Responsibilities," the Board agreed to change the term "Standing Panels" to "Subcommittees." The term "Task Forces" will remain for the more finite issue-specific groups that will be convened as budget and time allows. The list of proposed Subcommittees and Task Forces is as follows:

Subcommittees

- Water Quality (with initial focus on drinking water but with responsibility for all water sources and uses in the BD system with the exception of ecosystem restoration)
- Ag / Urban Water Use Efficiency and Water Recycling
- Water Supply and Modeling / CALSIM
- Organizational and Policy Change and Adaptive Management

Task Forces

- Levee System Integrity Risk Analysis
- Common Assumptions and Water Demand
- Water Management Aspects of the Delta Improvements Package (DIP)

The Board concluded that not all Subcommittees and Task Forces will be convened immediately, and that initial work will focus on Water Quality, Common Assumptions and Water Demand, and the DIP. Jack Keller noted that the BDPAC Water Quality Subcommittee had already framed several good questions for the WMSB to consider because EPA staff had held a workshop on this topic. However, Bill Glaze felt that the questions provided were more informational, and that he would prefer to convene the WMSB WQ Subcommittee with a number of consultants and other experts to frame questions. Daene McKinney expressed that it was difficult for the WMSB to frame questions at this point, and suggested that staff take a first cut. He also requested more information on areas of uncertainty to determine the most relevant questions. Helen Ingram expressed her hope that there would be a diversity of expertise within the Subcommittees and extensive communication and visitation between them.

WMSB MEMBER AND KEY STAFF AGREEMENTS AND ASSIGNMENTS

The Board agreed to establish four Subcommittees at this meeting. Tom Gohring will work with Johnnie Moore and Scott McCreary to formulate a first cut of charges to Subcommittees. The charges to the Subcommittees would include first drafts of questions / problem statements to be considered and refined by each Subcommittee via email and / or teleconference in advance of the WMSB's next plenary meeting in April or May.

Tom Gohring will also work with CBDA staff to compile the latest, most salient work products of each program that relate to the Subcommittees and Task Forces. He will send out these documents plus a short annotated bibliography of relevant web links within a month. As discussed at the meeting, the number of Subcommittees and Task Forces will depend on budget availability.

Tom Gohring and CBDA staff will additionally compile information requested by Board members on the:

- Watershed Management Program
- Proposal Solicitation Process
- Common Assumptions surface water storage process
- Water Quality ELPH concept
- Water Use Efficiency Comprehensive Analysis
- Levee System Integrity Comprehensive Program Evaluation

CBDA and CONCUR will also work together to set up a website from which WMSB members can download the presentations and materials presented at the meeting. They committed to email WMSB members the URL for this site within the next few weeks.

NEXT STEPS

Preparation of Key Outcomes Memorandum for the Public

CONCUR will work with WMSB members and CBDA staff to prepare a public Key Outcomes Memorandum. This document will be posted on the CBDA website as soon as it is complete.

ATTACHMENT 1 - PROGRAM ELEMENT BRIEFINGS

Day 1 featured a series of briefings on program elements and specific issues by CBDA and implementing agency staff. Chairs or representatives of the Water Supply, Water Quality, and Water Use Efficiency BDPAC Subcommittees also briefed the WMSB. A list of the briefings presented and their presenters is featured below, followed by a more detailed summary of these briefings.

Briefing Topic	Presenter
Water Supply ▪ Ground Water Storage ▪ Surface Water Storage ▪ Water Transfers ▪ Conveyance ▪ Delta Improvements Package	Mark Roberson, CBDA Staff ▪ John Woodling, Department of Water Resources ▪ ▪ Nannette Engelbrite, US Bureau of Reclamation ▪ Mark Roberson, CBDA Staff ▪ Don Kurosaka, Department of Water Resources ▪ Ron Ott, CBDA Staff
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Water Quality Subcommittee	Chair Greg Gartrell, Contra Costa Water District
Water Use Efficiency	Mark Roberson and Tom Gohring, CBDA Staff
Water Use Efficiency Subcommittee	Co-Chair Fran Spivy-Weber, Mono Lake Committee
Levee System Integrity	Sergio Guillen, CBDA Staff Curt Schmutte, Department of Water Resources
Environmental Justice	Ken McGhee, CBDA Consultant
Development of an integrated quantitative information system	Ken Kirby, DWR Consultant

Groundwater Storage

Mark Roberson introduced John Woodling to brief the Board on Groundwater Storage through the Conjunctive Water Management Program. The goal of the program is to increase storage capacity water supply reliability through locally managed conjunctive use projects and to encourage effective basin-wide groundwater management. In recognition that a state-driven, top-down approach would not meet the broader objectives of the program, the three-legged stool concept of local and regional capacity building, support for improved groundwater management, and financial assistance for construction of locally driven projects, project construction, capacity building, and groundwater management was developed to support water supply reliability.

The concept of linking water projects to greater local and statewide benefits was echoed throughout this presentation, as was the need to determine the broader environmental impacts and benefits of groundwater storage projects.

Surface Water Storage

US Bureau of Reclamation staff member Nannette Engelbrite gave a briefing on the five surface water storage project investigations recommended by the ROD: SLWRI (Shasta Lake), NODOS (Sites Reservoir), Los Vaqueros Reservoir, Upper San Joaquin River Basin, and In-Delta Storage. Engelbrite noted that feasibility studies are ongoing for the first four projects, and that these studies set the stage for possible construction (pending environmental approvals and Congressional appropriations). Bob Twiss noted that one role of the WMSB is to advise on the structure for the planning of the studies on these projects.

Engelbrite also discussed the efforts of the Common Assumptions team, which is working to develop a set of common tools (such as the CALSIM and DSM2 models), common inputs, and common reporting metrics. This team has recently added economics and cost metrics to achieve consistency across teams and agencies. They are also working on identifying a baseline by which to measure benefits. Jack Keller noted that at some level, the storage projects are in competition with each other; there is not a firm expectation that all five will be constructed.

Water Transfers

Mark Roberson and Tom Gohring briefly outlined the role of the CBDA in tracking and streamlining the regulatory process of transfers. The goal of this program is to lower the transaction costs of transfers, to increase the availability of information on transfers among the three implementing agencies (DWR, BOR, and SWRCB), and to minimize "third party" effects.

Conveyance

Don Kurosaka briefed the Board on the strategy of the Conveyance Program, which aims to use existing Delta Waterways to move water through the Delta to the export facilities. He briefly outlined the geographic range of the program's ten current projects, illustrated the challenges to implementing conveyance (such as Delta aquatic vegetation changes and the need for fish screens) and discussed the state of peer-review of the related study plans. He noted that while the study plans have been peer-reviewed by independent science reviewers, the study results have not yet been peer-reviewed. Stephen Monismith underscored the need for peer review of both study plans and results.

Ron Ott then discussed the Delta Improvements Package, which includes a suite of Delta improvement actions in the north, central, and south Delta as well as the lower San Joaquin River. He indicated how these actions are complementary, such as increasing flows and improving water quality using recirculation in the lower San Joaquin. He showed how this could improve the dissolved oxygen in the Stockton Ship Channel and water quality in the South Delta. Also, reducing salinity by modifications of Franks Tract could improve drinking water quality for major diverters in the Delta.

Other complementary projects were also discussed. He noted the need for better understanding on how flow and fish move through the Delta under various conditions.

Water Supply Subcommittee

On behalf of the Water Supply Subcommittee, Mark Cowin, Manager of Planning and Local Resources for DWR, discussed the Subcommittee's broad agreement on the need for better, more comparable information to help make more informed decisions for the broader CALFED process. He reviewed the California Water Plan Update Bulletin 160 process, which contains two primary initiatives: 1) regional, integrated water management plans, and 2) statewide infrastructure improvements that include new strategies for flood management and the implementation of the Bay-Delta program. He noted that in contrast to past water plans, the current iteration (officially year 2003) explicitly includes multiple scenarios and a suite of management tools.

In response to a question, Cowin noted that climate change is indeed a variable in the Water Plan, and that future Plan updates will increasingly incorporate different climate change scenarios as they are developed.

Water Quality

In their presentation on drinking water quality, Liz Borowiec of the EPA and Lisa Holm of CBDA identified constituents of concern, action areas, and investments to date. They introduced the multiple barrier principle, which is applied by the Water Quality Program as the concept of an “Equivalent Level of Public Health Protection” (ELPH) to numeric targets, as specified in the ROD. The basic strategy is to examine all opportunities to protect and improve drinking water - in the source waters, through its conveyance and storage, and during treatment.

They touched on the current program assessment effort, development of performance measures, and noted that most of their investments have yet to be actually spent. They also outlined their immediate priorities, developed through a two-year strategic planning process, as well as the Water Quality Subcommittee's list of critical issues for WMSB consideration, namely treatment technologies and the potential development of "Water Quality Index/Indices" (monitoring to link raw water quality to delivered water quality).

Board members posed questions to them about consideration of the cost effectiveness of providing household-level water quality technology such as RO/point-of-use and point-of-entry treatment systems versus investing in more general water quality improvements in the event of catastrophic Delta failure. They responded that this is an area still being explored by local utilities, and should local utilities find it as a viable treatment, CBDA would work to incorporate its consideration into ELPH. They also pointed out the availability of real-time data due to CBDA investments, and the existence of infrastructure that acts to attenuate or delay the effects of catastrophic failures in the Delta to the majority of the population. Greg Gartrell noted that local

utilities have been increasingly discussing services that could be provided to people who have a greater concern for drinking water quality.

Water Quality Subcommittee

Greg Gartrell, Chair of the Water Quality Subcommittee, discussed how a major focus of the Subcommittee is using ELPH to meet anticipated drinking water standards. He noted that while the real concern for drinking water is pathogens, other constituents are a focus because of disinfection by-products (health hazards) and taste and odor issues. This issue of maximizing benefits was discussed in regard to many topics, such as the use of point of use/entry devices to address water quality, the conflict between seasonal water quality and seasonal use needs, and the consequences of switching from chlorine to chloramine treatment, or adding ozone or other disinfectants. The high variability of Delta water quality, multiple goals for treated water quality, the potential of decentralized treatment, and the redirected impacts of switching disinfectants (the conflict between public health and aesthetics) is the essence of the problem.

In order to protect the supply to the tap, a disinfectant residual is required (i.e., membrane filtration with no disinfection because water can become contaminated through leaks or re-growth in the system). A disinfectant residual means that by-products will be produced. The challenge remains to disinfect the water and meet regulation on by-products. Since by-products can be substantially reduced if there is little or no bromide in the source water, protection of Delta water from seawater (a source of bromide) is imperative. That leads to the conflict with water supply and ecosystem improvements over water resources necessary to improve in all three areas. This leads to the ELPH approach, which deals not only with Delta improvements, but also with improvements in every area, from source water to conveyance, treatment and distribution.

In addition, determining benefits, in the context of determining when public health standards have been achieved, was another aspect of the issue. Gartrell noted that the benefits of the public health index that is being developed are still being discussed. He also noted the two questions for the WMSB that had emerged from Drinking Water Quality Subcommittee discussions, which are summarized as follows:

- Given the domain of the CALFED solution area and the opportunity to seek regional solutions for water quality improvements, how might CBDA technically evaluate the tradeoffs between source improvements and treatment for the various (and possible future) contaminants of concern?

- What is the applicability and feasibility of developing "Water Quality Indices" (WQI)? In other words, how widely or narrowly should the WQI be focused, and what are the scientific/technical limitations in producing them?

Bill Glaze and Michael Anderson agreed to work with CBDA staff and the Drinking Water Quality Subcommittee to further refine an approach to these and other possible questions that might be taken up by the Water Quality Subcommittee.

Water Use Efficiency

In his briefing on water use efficiency, Tom Gohring first laid out the program's conceptual framework. This framework considers the actions taken to increase water use efficiency as tools to accomplish CALFED's goals, and that these tools are dependent on local action. Gohring noted the program's work on passing water use measurement legislation and on the development of WUE performance measures. He also discussed the benefits-based process in which water conservation projects are rated against each other.

Board members posed questions as to how the process can encourage innovation, and about how it can avoid the "free rider effect" of giving grants for projects that would happen anyway. Gohring noted that the grant program encourages pilots and feasibility studies at a local scale, and highlighted the positive spillover effects of local innovation. Board members also asked about the eligibility of private companies to obtain grants, and whether these funds can be used as a sort of "venture capital" to encourage innovation. Gohring responded that private companies are welcome to apply, but due to inconclusive public policy he could not guarantee their eligibility, and that there are existing grant programs through DWR that can be applied to innovative new projects.

Water Use Efficiency Subcommittee

Subcommittee Co-Chair Fran Spivy-Weber praised the broad range of representatives on this Subcommittee, their collegial work ethic, and their commitment to conservation. She framed the issue of water use efficiency as a set of integrated tools that could be used to solve a number of water use conflicts, and noted that the research done on the cost-effectiveness of WUE has been substantial and supportive of the benefits of WUE.

Spivy-Weber also commented on the use of joint fact-finding to help resolve water use disputes, and how this structure was used successfully to inform the WUE Program Subcommittee and the Finance Plan.

Levee System Integrity

Curt Schmutte gave an overview of the history of levees in the Delta, threats to levee stability such as floods and earthquakes, and illustrated the impact of levee failures (such as the recent Jones Tract levee break) on salinity levels and the state's water supply. He presented a simulated scenario of levee failure on multiple islands to exhibit the intrusion of salinity in the Delta. He added that the economic impacts of a scenario in which the SWP was shutdown are impossible to model, but that they would be large.

Schmutte discussed the impact of subsidence on levee cost, cost sharing arrangements, and an array of potential options and inherent policy tradeoffs in alternate strategies to protect the land and the water system of the Delta. He suggested that the concept of "predictable surprises" to frame this issue. He noted the link between agriculture and

subsidence, and the implied need for increased investment in levees because of the effect of the former on the latter. He also mentioned research underway on subsidence and seismic risk analysis, and on the use of various materials and practices (such as adding rice straw and injecting material beneath peat) to combat subsidence.

Schmutte summarized the option of intentionally flooding of selected islands, which could improve salinity levels by reducing tidal amplitude. Board members discussed the consequences of intentionally flooding islands, the cost of purchasing islands to flood, the feasibility of purchasing islands, and the likelihood of a long-term transition period accompanying landscape changes associated with intentional flooding. The Board also noted the prospects and consequences of a policy choice to more clearly decouple agriculture and water supply.

Environmental Justice

Ken McGhee, Environmental Justice Manager for CBDA, explained in his briefing how environmental justice is an activity within CBDA's mandate of oversight and coordination, and a tool to achieve the objectives as outlined in the ROD. In the context of CALFED, he defined environmental justice as the provision of equal levels of environmental protection for all, and noted that in California, environmental justice communities are not only based on race or tribal affiliation, but also include constituencies characterized by geography and socio-economic situation.

He emphasized that CALFED environmental justice activities focus on having the right process in place so that issues of equity are integrated into and addressed by program plans. He highlighted the need to move from advocacy to action on issues such as public health and disaster planning, and mentioned his efforts to work and meet with constituencies outside of Sacramento.

Board members queried whether there were areas of water conservation that have particular influence on distributional equity. McGhee mentioned conservation efforts that impact public health as a major environmental justice issue. In regard to distributional equity, McGhee also identified disaster planning as a field that needs to address not only the total cost of a problem but also by whom that cost would be borne.

McGhee would like to be more proactive in terms of offering suggestions to enhance watershed planning, the water conservation grant program, and other aspects of CBDA. In response to a question on the availability of information to make a strong case for environmental justice, he replied that capacity building continues to be an issue, but that watershed and WUE grants could help address this by including environmental justice criteria in their solicitation process.

ATTACHMENT 2 - BIOGRAPHIES OF WMSB MEMBERS AND KEY STAFF

BOARD MEMBERS

Jack Keller - Interim Chair, Water Management Science Board
Principal, Keller-Bliesner Engineering
Professor Emeritus, Utah State University
Dr. Keller is a member of the CALFED Independent Science Board (ISB) and of the National Academy of Engineering. He is a researcher, author and advisor on water resources and development focused on agricultural water use. He is considered an international expert in irrigation, water conservation, and water resources planning in irrigated regions. He serves as an advisor and lead scientist to the California Bay-Delta Authority's Water Use Efficiency Program. He also leads the Conservation Verification Consultants who are responsible for quantifying the agricultural water conservation savings resulting from the Imperial Irrigation District / Metropolitan Water District of LA Conservation Agreement. He has a degree in civil engineering and earned his doctorate in agricultural and irrigation engineering at Utah State University.

Michael Anderson
Associate Professor, Department of Environmental Sciences, UC-Riverside
Dr. Anderson conducts research on a number of topics related to surface water quality, including internal loading and nutrient cycling in lakes, surface water quality modeling, recreational impacts on microbial water quality and public health, and lake and reservoir restoration and management. He has worked closely with the RWQCB, DHS and other organizations on issues in southern California lakes and reservoirs. Prior to joining the faculty at UC-Riverside, he worked as an environmental chemist at the Savannah River Ecology Lab, University of Georgia and as a hydrologist for the BLM. He received his Ph.D. in environmental chemistry from Virginia Tech.

Takashi Asano
Professor Emeritus, Civil and Environmental Engineering, UC-Davis
Dr. Asano has over 35 years of academic and professional experience in environmental and water resources engineering in the US and abroad. His areas of specialization and research interests include planning and regulatory aspects of water resources development and reuse, environmental and water resources engineering, wastewater reclamation and reuse, and groundwater recharge. He served over 10 years as the Water Reclamation Specialist for the SWRCB and has conducted major water reclamation and reuse studies, many of which become the scientific and technical basis for the current California's Title 22 regulations. He received his B.S. in Agricultural Chemistry at Hokkaido University in Sapporo, Japan, his MSE in Civil Engineering at UC Berkeley, California, and his Ph.D. in Environmental and Water Resource Engineering from the University of Michigan, Ann Arbor.

Tom Chesnutt
Co-founder, A & N Technical Services, Inc.
Dr. Chesnutt is one of the leaders in this field of urban water use efficiency. He has broad experience in the application of statistical modeling, simulation, and risk analysis to policy issues in areas such as conservation-oriented water rate design, demand estimation, supply simulation, natural resource economics, environmental policy, and

developing decision support software for integrated resource planning for water utilities. He received his B.A. in Economics from Kenyon Collage, his M.S. in Technology and Science Policy from the Georgia Institute of Technology and his Ph.D. in Public Policy Analysis with a Distinction in Economics from the RAND Graduate School.

Michael Dettinger
Research Hydrologist, USGS and Scripps Institute of Oceanography
Dr. Dettinger has extensive knowledge of Sierra Nevada watershed hydrology and is well known for his work related to hydrology and climate change. He is a Research Hydrologist for the Branch of Western Regional Research, USGS, and a Research Associate of the Climate Research Division at Scripps Institution of Oceanography in La Jolla. His current work includes **s**tudies of: global and Sierra Nevadan hydro-climatology of precipitation, snow-packs, and stream flow; and evaluation of climate-change projections for changes in large-scale Pacific-basin climate modes and resulting streamflow changes. He earned a BA in Physics from UC San Diego, an MS in Civil Engineering from MIT an MS in Atmospheric Sciences from UCLA, and his doctorate in Atmospheric Sciences from UCLA.

Jody Emel
Professor, Graduate School of Geography, Clark University
Dr. Emel is a cultural geographer with a background in risk analysis, hydrology, sustainability, and water resources. She has published in the area of natural resource development and groundwater management and over-development. She brings an interesting perspective in terms of the socio-environmental aspects of water resource development with an understanding of the underlying physical and natural sciences. She earned her B.A. in Geography from the University of Kansas at Lawrence, her M.S. in Geography from Pennsylvania State University at State College, and her Ph.D. from the University of Arizona in Hydrology and Water Resources with a minor in Soils, Water, and Engineering.

William Glaze
Professor, Department of Environmental and Biomolecular Systems, Oregon Health and Science University
Dr. Glaze is a member of the CBDA Independent Science Board and an expert in water quality and drinking water treatment. He served on the National Academy of Sciences Board of Environmental Studies and Toxicology and as Chair of a Panel that developed the Water Treatment Chemicals Codex. He is a former chair of the US EPA Science Advisory Board Drinking Water Committee and recently retired as Chair of the SAB on Oct. 1, 2004. He has extensive research and public service experience in the areas of environmental policy, regulations, and research planning. His research focused on disinfection, disinfection byproducts, ozone and chlorine chemistry, analytical methods and monitoring, and pilot studies of oxidation, adsorption and biodegradation processes. Dr. Glaze was the editor of Environmental Sciences & Technology from 1988-2003. He received his doctorate in physical chemistry from the University of Wisconsin.

Helen Ingram
Professor of Social Ecology, UC-Irvine
Dr. Ingram's research focus is on water resources and equity issues, and she has participated in numerous science conferences and symposia convened by the California Bay-Delta Authority. She is an expert in environmental and water policy design and implementation and has done extensive research into institutional change and the impact of policy on democracy and public participation. She has authored and edited a dozen books and over a hundred peer-reviewed articles and book chapters. Dr. Ingram is a member of the CALFED Independent Science Board and has served on CALFED's Environmental Water Account Review Panel from 2001 to 2005. She received her doctorate in public law and government from Columbia University, and taught at the University of Arizona for twenty-five years. She has held the Warmington Endowed Chair in Social Ecology at the University of California at Irvine since 1996.

Denise Lach
Associate Professor, Department of Sociology,
Co-Director, Center for Water and Environmental Sustainability, Oregon State University
Dr. Lach is an expert on the role of science in environmental decision-making, organizational change, and organizational behavior. Her teaching / research focuses are: environmental sociology; applied research methods; organizational sociology (use of information in organizational decision making); and conflict and dispute resolution. Her Interdisciplinary and synergistic activities include: inter-disciplinary research managing projects funded by the USGS, EPA, and NSF at the Center for Water and Environmental Sustainability (CWESt), which serves as a catalyst for interdisciplinary research at OSU. She earned her B.S. in English / Education from the University of Minnesota and her M.S. and Ph.D. in Sociology from the University of Oregon.

John Melack
Professor, Donald Bren School of Environmental Science and Management, and Department of Ecology, Evolution and Marine Biology, UC Santa Barbara
Dr. Melack is internationally recognized as a scientific expert on lake ecosystems, catchments, floodplain systems and effects of climate change on aquatic systems and conducts research in limnology, biogeochemistry, and remote sensing with experience in Africa, South and North America and Australia. He has served on the National Academy of Sciences Committee on geophysical and environmental data and on advisory committees to NASA on uses of remote sensing and is a member of the CALFED Independent Science Board. His familiarity with the issues related to in-Delta storage, aquatic biogeochemistry, remote sensing, and climate change are all vitally important technical issues that the Board will be addressing. He earned his doctorate in zoology from Duke University.

Daene McKinney
Professor, Department of Civil Engineering, University of Texas at Austin
Dr. McKinney is a professor of Environmental Engineering at the University of Texas at Austin. He concentrates on research related to transboundary water and environmental issues, especially related to US-Mexico border issues in the Rio Grande basin and countries of Central Europe and the Former Soviet Union. Of particular interest to him is the relationship between economic development and environmental protection. Dr.

McKinney is an experienced modeler for river basin systems and has experience at the operational level in river basin management. Working with public agencies, he was one of the senior modelers brought in to assist CALFED in reviewing the CALSIM II Model and co-authored the resulting report. McKinney has served as an environmental engineer for the U.S. Environmental Protection Agency and spent a two-year leave from UT Austin in Almaty, Kazakhstan as Chief of Party for the five-country USAID Environmental Policy and Institutions for Central Asia (EPIC) Program. He received his Ph.D. and M.S. degrees in Civil and Environmental Engineering from Cornell University and a B.S. in Environmental Resources Engineering from Humboldt State University.

Stephen Monismith
Professor, Department of Civil and Environmental Engineering, Stanford University
Dr. Monismith's research is in environmental and geophysical fluid dynamics involving the application of fluid mechanics principles to the analysis of flow processes operating in rivers, lakes, estuaries, and the oceans. He is an expert on fluid flows in complex systems. His current research includes studies of estuarine hydrodynamics and mixing processes, flows over coral reefs, wind wave-turbulent flow interactions in the upper ocean, turbulence in density stratified fluids, and physical-biological interactions in phytoplankton and benthic systems. Because his interest in estuarine processes is intertwined with an interest in California water policy issues, he has been intimately involved with CALFED efforts at developing models and management strategies for improving the "health" of the Bay-Delta system. He received his B.S, M.S. and Ph.D. in Civil Engineering from UC-Berkeley.

Richard Norgaard
Professor of Energy and Resources and of Agricultural and Resource Economics, UC-Berkeley
Professor Norgaard's areas of interest are epistemology and sociology of understanding complex systems, ecological economics, and economics of development, energy, environment trade, and sustainability. His research emphasizes the contradictions between neoclassical economic theory and biological and social science understandings of nature and society, how the resolution of complex socio-environmental problems challenges modern beliefs about science and policy development, and development as a process of co-evolution between social and environmental systems. Dr. Norgaard has served on the Science Advisory Board of the U.S. EPA and as a member of the U.S. Committee of the Scientific Committee on Problems of the Environment (SCOPE), in addition to numerous other panels and boards. He received his BA in Economics from UC Berkeley, an MS in Agricultural Economics from Oregon State University, and his doctorate in Economics from the University of Chicago.

Robert Twiss
Professor in the Graduate School, UC-Berkeley
Dr. Twiss is a member of the CALFED Independent Science Board and is Co-Chair of CALFED's Ecosystem Restoration Program Science Board. He is also a member of the US EPA Science Advisory Board, which has oversight of science aspects of all EPA programs, including water quality. As an expert in environmental and regional planning, he has been involved in all levels of planning and research for local, regional, state, and federal agencies as well as the United Nations. He directed the Research

Program in Environmental Planning & GIS at UCB, directing planning studies for the SF Bay and Delta. He is founder and president of Geostage, Inc., which develops web-based GIS tools. He received his doctorate from the School of Natural Resources, The University of Michigan.

Dennis Wichelns
Professor of Agricultural Economics, California State University, Fresno and Chief Economist, California Water Institute
Dr. Wichelns' specializations are: agricultural and natural resource economics, water economics and policy, irrigation and drainage economics, and international development. His current research includes analysis of water supply and demand issues in California, irrigation and drainage issues, particularly in the San Joaquin Valley, transboundary competition for water, desalination, and efforts to enhance environmental quality by improving water management. His expertise is heavily focused on economic issues pertaining to irrigation, which is the major consumptive use of water in California. Dr. Wichelns brings a strong irrigation focus to the Board and he provides a link with the California Water Institute, located in Fresno. Dr. Wichelns has worked on a large fruit and vegetable farm and he has managed the University of Maryland's Plant Research Farm. He has a BS in Pomology and an MS in Agricultural Economics from the University of Maryland, and a Ph.D. in Agricultural Economics from the University of California, Davis.

William Woessner
Professor of Hydrogeology, University of Montana
Dr. Woessner is a hydrogeologist with particular expertise in modeling and in analyzing models at their most basic level. He has experience in consulting on groundwater resource issues throughout the western United States, including using models to predict the effect of development on water supply. Dr. Woessner has worked on tribal lands and Superfund sites and in pristine environments, looking at a wide range of problems related to water quality and quantity, including toxics contamination, virus transport, nutrients, surface water / groundwater interaction. His interdisciplinary work is exemplified by his present research funded by the National Science Foundation's Biocomplexity and Microbial Observatory programs. In 2004, Dr. Woessner was named Regents' Professor by the University of Montana, and has also recently been selected to be the Birdsall-Dreiss Distinguished Lecturer of the Hydrology Division of the Geological Society of America for 2005. He earned his Ph.D. in geology (hydrogeology with a minor in civil and environmental engineering) from the University of Wisconsin-Madison. He also holds an M.S in geology from the University of Florida and M.S in water resources management from the University of Wisconsin.

PROGRAM STAFF AND CONSULTANTS

Tom Gohring
Deputy Director for Water Management and Regional Coordination
California Bay-Delta Authority
Tom Gohring is the Deputy Director for Water Management and Regional Coordination at the California Bay-Delta Authority. Mr. Gohring is a licensed Civil Engineer and earned his Master of Science in Engineering from UC Davis and his Bachelor's degree in Agricultural Engineering from Cal Poly, San Luis Obispo.

The Authority provides oversight and coordination for the CALFED Bay-Delta Program, a cooperative effort among 23 state and federal agencies and the public to ensure a healthy ecosystem, reliable water supplies, and good quality water in California. During his first three years with the CALFED process, Mr. Gohring was Program Manager of the Water Use Efficiency element, which includes water conservation and recycling. Mr. Gohring played a key role as convener of several independent review panels for the CALFED Program, including a panel evaluating conservation potential and one aimed at developing a definition of appropriate water measurement. Prior to joining the CALFED team, he led several interdisciplinary water management projects under the employ of large and small public agencies and large and small consulting firms including the U.S. Bureau of Reclamation, the Kings River Conservation District, and CH2M Hill, Inc.

Valerie Castro
Administrative Officer for Water Management
California Bay-Delta Authority
Valerie Castro has worked in the public and private sectors for 18 years. In the private sector she was the Administrative Assistant for a lobbying firm in California. Prior to joining the CALFED team, Ms. Castro spent three years at the Department of Water Resources providing clerical support to their Division of Land and Right of Way. During her eight-year term at the CALFED Program, Ms. Castro has held positions as Executive Secretary and Human Resources Analyst. In her current position as Administrative Officer for the Bay-Delta Authority's Water Management Division, Ms. Castro also serves as primary point of contact within the Authority for the Water Management Science Board.

Scott McCreary
Principal and Co-Founder, CONCUR, Inc.
Water Management Science Board Facilitator
Dr. Scott McCreary is Principal and Co-Founder of CONCUR, Inc., a California-based firm providing services in agreement-focused facilitation, environmental policy analysis, and strategic planning. He received a BA in Environmental Planning and Biology from UC Santa Cruz, a Master's Degree in Landscape Architecture / Environmental Planning from UC Berkeley, and his doctorate from MIT's Department of Urban Studies and Planning. His research at the MIT-Harvard Public Disputes Program examined the exchange of scientific information to support policy agreements on complex environmental issues. Dr. McCreary has convened a dozen independent review panels on complex natural resource issues. He convened CALFED's first independent review panel on the Ecosystem Restoration Program Plan.

He teamed with Dr. Jack Keller and Tom Gohring in the independent review on Water Conservation Potential, which helped launch CBDA's current Water Use Efficiency Program. He convened an independent review of the effect of timber harvesting practices in California's Headwaters Forest region. A current project is facilitating the organizational structure for a new Lake Tahoe Science and Research Consortium.

Dr. McCreary has managed interdisciplinary teams in over 40 major multiparty projects aimed at consensus building, policy development, and dispute resolution. These initiatives spanned water supply, flood control, water use efficiency, ecosystem restoration and climate change. As a neutral, he has maintained strong professional relationships with dozens of negotiation participants across the spectrum of organizations active in environmental decision-making. He has taught 60 courses in environmental planning and conflict resolution and worked in 15 nations. A recent project emphasized joint fact-finding for transboundary water resources management for the Okavango Basin, Southern Africa. He has authored over 40 publications on joint fact-finding, natural resource planning, negotiation theory, and science advising for public policy.

Xantha Bruso
Associate, CONCUR, Inc.
Water Management Science Board Co-Facilitator and Recorder
Ms. Bruso is an Associate at CONCUR Inc. She earned her B.A. in Geography and Asian Studies from Dartmouth College and her Master of City Planning degree from MIT, where her thesis investigated incentives for stakeholder participation in Latin American forest carbon sequestration projects. At CONCUR, Ms. Bruso has contributed to several projects involving scientific review of complex natural resource issues. She co-facilitated an independent scientific review panel on the effects of timber harvesting practices in California's headwaters forest region, conducted research on organizational structures for a new Lake Tahoe Science Consortium, contributed to a review of the Clean Estuary Partnership (a consortium focused on TMDL development for San Francisco Bay), and worked on a Strategic Plan for the NOAA Fisheries Pacific Islands Region. Ms. Bruso has also developed and taught several of CONCUR's customized training courses. Prior to CONCUR, Ms. Bruso worked at the Pacific Institute as well as at economic consulting, environmental consulting, and coastal management organizations.